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A SEED COTTON CLEANER WITHOUT MOVING PARTS

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A research project initiated in 1961 at the U.S. Cotton Ginning Research Laboratory, Stoneville, Miss., included as its objective the possible design and development of new seed cotton cleaning devices.

This work has resulted in the design, fabrication, and installation of an in-the-air serpentine cleaner that has no moving parts except the trash conveyor. The cleaner requires no additional air volume for operation and, therefore, requires no additional horsepower, except that needed to operate the trash conveyor and to overcome the additional resistance in the curved duct. The power needed for these items is negligible.

Description of the Cleaner

A salient feature of this new seed cotton cleaner is its simplicity. The device consists of adjustable triangular grid bars placed at strategic positions in the cotton passageway or in a concave portion of a curved rectangular air duct to provide the cleaning action. A trash chamber complete with discharge conveyor is provided to receive and dispose of the foreign matter as it is ejected through the cleaning grids (Fig. 1). A public service patent has been granted on this cleaner.[2/]

PRELIMINARY EXPERIMENTS IN 1961

In 1961, a model of the serpentine cleaner was made for use in preliminary investigations and was installed immediately after a USDA boll trap, which followed a 24-shelf tower drier in the three-stand laboratory gin system at Stoneville.[3/] A heavy, clear plastic sheet was used for one side of the cleaner to permit observation during operation (Fig. 2). The clear sheet also

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2/ U.S. Patent No. 3,096,276, Apparatus and Methods of Cleaning Seed Cotton, issued July 2, 1963.

3/ Franks, G. N., and Griffin, A. C. Jr., Foreign matter trap for cotton gins. U.S. Dept. Agr. Cir. 973. 1955.

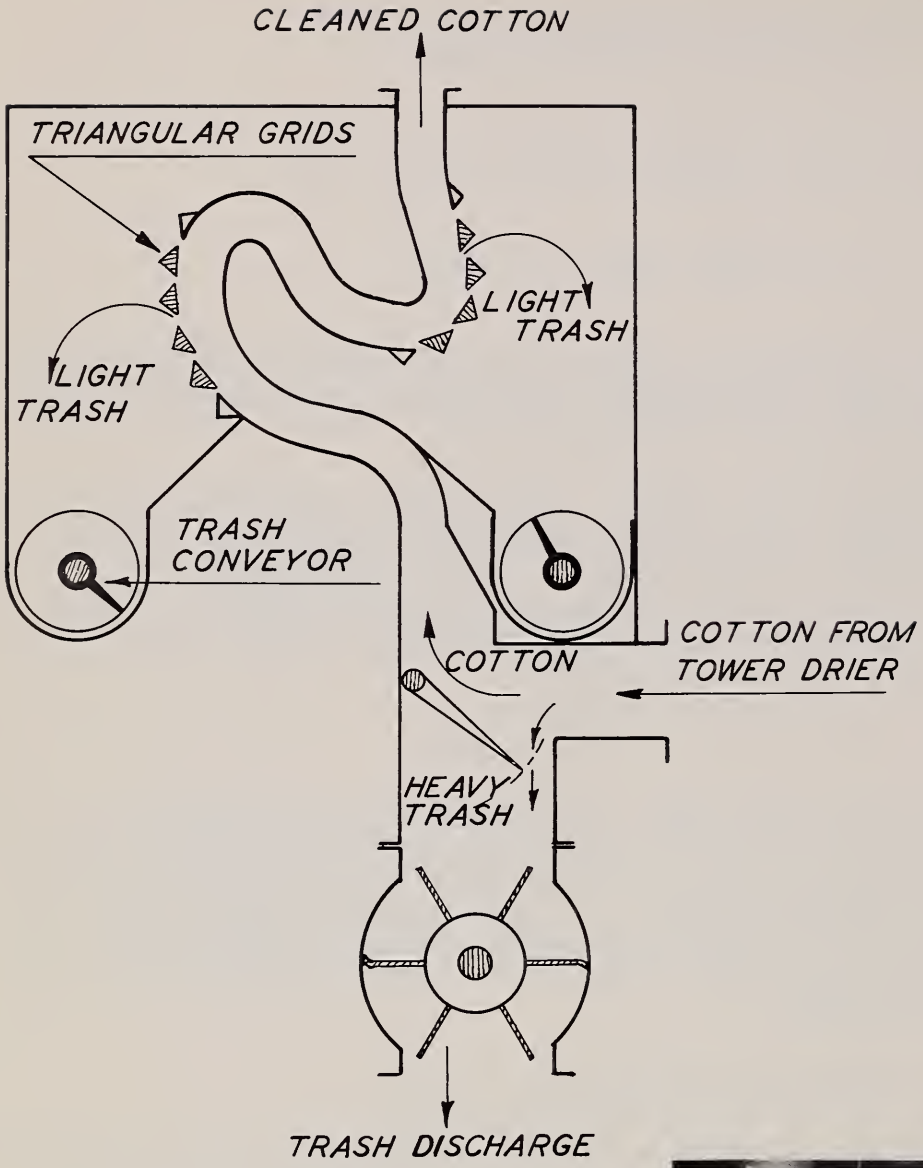

Figure 1. Cross section drawing of the serpentine cleaner.

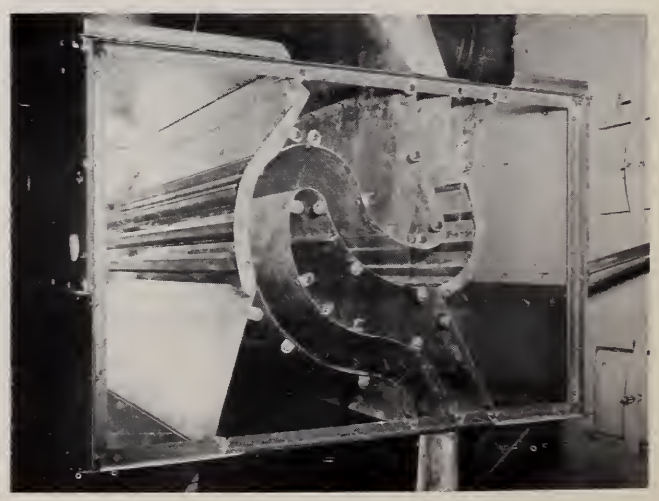

Figure 2. View of serpentine cleaner through sheet of clear plastic.

facilitated the taking of high-speed movies for use in studying the cleaning action. In the first test run made with this device, promising cleaning action was obtained (Figs. 3 and 4). Preliminary trial experiments were, therefore, provided for in the testing program.

During the trial-adjustment experiments, triangular grids and round grid rods were both used in the serpentine cleaner. Each gave about the same result on both hand-picked and machine-picked cotton, but the triangular grids offered the advantage of adjustment. The cleaner equipped with either the round rods or the triangular grids removed 6.6 pounds of foreign matter from a bale of machine-picked cotton. These trash-removal weights compare with a total trash removal of 15.4 pounds of predominantly fine trash from the same kind of cotton by a revolving-screen cleaner. The serpentine cleaner as tested had approximately one-twelfth the open cleaning area of the revolving-screen cleaner, but the amount of foreign matter removed by the serpentine cleaner is 42.8 percent of that removed by the revolving-screen cleaner. The foreign matter was predominantly leaf and pin trash, but also included small amounts of sticks and stems, grass and motes.

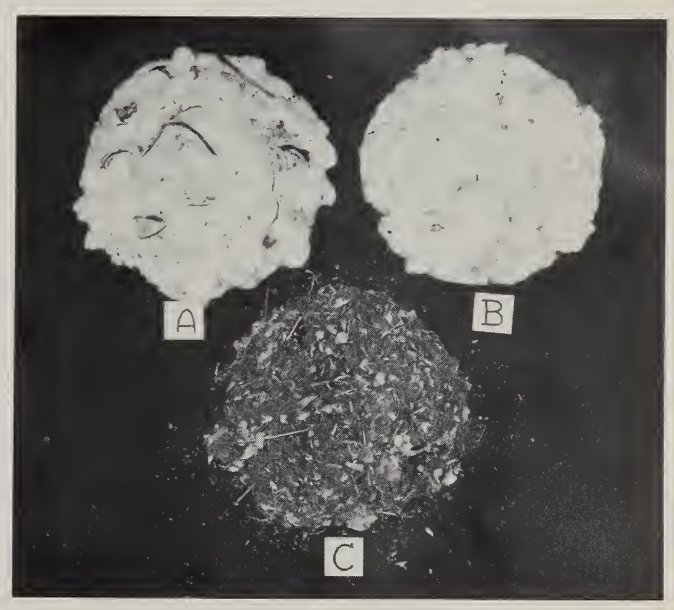

Figure 3. Cotton and trash involved in the initial serpentine cleaner test. A, Wagon sample; B, cotton after passage through serpentine cleaner; and C, type of trash removed by the cleaner.

Figure 4. Trash removed by serpentine cleaner.

Further Experiments in 1963

Some redesign work was done on the serpentine cleaner in 1963 to provide more cleaning area and a more efficient trash chamber. To obtain additional information as to the possible cleaning effectiveness of the serpentine cleaner, the following machinery arrangements (setups) were used for processing two replications of machine-picked cotton:

1. 7-cylinder cleaner and extractor-feeder.

2. Revolving-screen cleaner and extractor-feeder.

3. Serpentine cleaner and extractor-feeder.

4. 7-cylinder cleaner, unit stick remover, 7-cylinder cleaner, and extractor-feeder.

5. 7-cylinder cleaner, unit stick remover, 7-cylinder cleaner, extractor-feeder and two lint cleaners.

6. Serpentine cleaner, 7-cylinder cleaner, unit stick remover and extractor-feeder.

7. 7-cylinder cleaner, unit stick remover, serpentine cleaner, 7-cylinder cleaner and extractor-feeder.

8. 7-cylinder cleaner, unit stick remover, serpentine cleaner, extractor-feeder and two lint cleaners.

A multipath drier set at 220° F. preceded each of the above machinery arrangements.

The experiment was designed to compare the developmental serpentine cleaner as an individual device with the 7-cylinder cleaner and the revolving-screen cleaner and to see what effect it might have in combination arrangements.

In total area of both grids and openings under the cylinder, the 52-inch cleaner compares with the serpentine cleaner as follows: One cylinder of a 52-inch cleaner has a cleaning area of 17 by 52 inches, or 884 square inches. Seven cylinders were used. The serpentine cleaner has a cleaning area of 20 by 48 inches, or 960 square inches, which is approximately the same area as one cylinder of a 52-inch cleaner.

The machine-picked cotton used in this experiment was above average in trash content. The total wagon-sample foreign matter content was 8.7 with a breakdown as follows: Hulls, 2.1; sticks and stems, 0.7; grass, 0.1; large leaf, 1.8; small leaf, 2.6; total leaf, 4.4; pin trash, 0.2; and motes, 1.2 percent. This cotton was comparatively heavy in leaf content.

The test results are presented in table 1. The developmental model did not take out so much trash as the 7-cylinder cleaner or as the revolving-screen cleaner, and the cleaning it accomplished was somewhat hidden in combination arrangements. This is the case for any overhead cleaner and is demonstrated by the equalizing effects obtained when double lint cleaning is used in combination arrangements, as in setups 5 and 8. Nevertheless, the serpentine cleaner did remove sizeable amounts of trash consisting principally of leaf, pin trash, hull fragments, and motes, with some stems included.

Because the developmental model serpentine cleaner had less cleaning area than the 7-cylinder cleaner, another test was designed to give a more equitable comparison.

In this test, the machine-picked seed cotton was processed in three replications as follows:

1. Once through the 7-cylinder cleaner and extractor-feeder.

2. Three times through the serpentine cleaner and once through the extractor-feeder.

3. Five times through the serpentine cleaner and once through the extractor-feeder.

The test results are presented in table 2. These results show that, without any important differences in fiber or spinning quality, the three- and five-time passes through the serpentine cleaner gave substantially better cleaning and better grade than was obtained with 7-cylinder cleaner.

In view of the fact that the serpentine cleaner would be used in combination with other machinery, a commercial model of this cleaner would have adequate capacity if it provides about three times the cleaning grid area of the developmental model.

The serpentine cleaner has no moving parts and accomplishes its cleaning by use of grids in the airline system through a scrubbing action it gives the cotton as it passes through the cleaner. The horsepower requirement for this operation is negligible.

Table 1. Effectiveness of the serpentine cleaner compared with other individual seed cotton cleaners and combination arrangements--Crop of 1963

[Multipath drier set at 220° F. preceded the cleaning. Test values are averages of six samples--three each for two replications]

Machinery used	Setup no.	Classification		Foreign matter content of lint	Moisture content		
		Grade 1/	Staple length		Wagon sample	Feeder sample	Lint sample
		Index	32ds in.	Pct.	Pct.	Pct.	Pct.
7-cylinder and extractor feeder	1	83.3	33.0	6.57	9.5	8.0	4.7
Revolving-screen cleaner and extractor-feeder	2	81.0	33.0	7.34	10.0	7.7	4.4
Serpentine and extractor feeder	3	75.3	33.0	8.95	9.7	7.4	4.2
7-cylinder, stick remover, 7-cylinder, and extractor cleaner	4	90.0	33.2	5.45	9.6	7.2	4.0
7-cylinder, stick remover, 7-cylinder, extractor-feeder, and 2 lint cleaners	5	100.7	33.5	1.90	9.0	7.0	4.2
Serpentine, 7-cylinder, stick remover, and extractor-feeder	6	85.0	33.0	6.09	10.0	7.2	4.1
7-cylinder, stick remover, serpentine, 7-cylinder, and extractor-feeder	7	92.3	33.3	4.27	9.5	6.7	3.8
7-cylinder, stick remover, serpentine, 7-cylinder, extractor-feeder, and 2 lint cleaners	8	100.0	33.5	1.89	9.4	7.1	3.6

1/ 100 = Middling; 97 = SLM plus; 94 = SLM; 90 = LM plus; 85 = LM; 81 = SGO plus; and 76 = SGO.

Table 2. Effectiveness of serpentine and 7-cylinder cottonseed cleaners in stated tests--Crop of 1963

[Seed cotton was machine picked and averaged 5.4 percent foreign matter. Cotton was passed once through multipath drier at 225° F. Test values are averages of nine samples--three for each of three ginned lots]

Test item	Seed cotton cleaning arrangement		
	Once through 7-cylinder cleaner and extractor-feeder	Three times through serpentine cleaner; once through extractor-feeder	Five times through serpentine cleaners; once through extractor-feeder
Classification:			
Grade, index	81.0	87.0	94.0
Staple length, 32ds inch	34.0	34.0	34.0
Foreign matter content of lint, percent 1/	4.10	3.81	3.16
Spinning and fiber data:			
Digital fibrograph			
Span length:			
66.7 percent, inch	.38	.38	.37
50.0 percent, inch	.50	.50	.49
2.5 percent, inches	1.13	1.14	1.13
Uniformity, index	44	44	43
Fibers shorter than 1/2-inch, percent 2/	12.7	11.7	11.4
Yarn:			
Skein strength, pounds	103	104	102
Coefficient of variation, percent	4.9	4.5	5.0
Raw stock nep count, 100 sq. in. of web	18.3	18.3	20.7
Micronaire reading	4.6	4.7	4.7

1/ As determined by Shirley Analyzer tests.
2/ As determined by fiber arrays.

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Summary

Research work at the U.S. Cotton Ginning Research Laboratory, Stoneville, Miss., has resulted in the development of an in-the-air serpentine seed cotton cleaner, which has no moving parts except the trash conveyor. The horsepower needed to operate the trash conveyor and to overcome the additional resistance in the curved duct is negligible.

A salient feature of this new seed cotton cleaner is its simplicity. The device consists of adjustable triangular grid bars placed in strategic positions in the cotton passageway or in a concave portion of a curved rectangular air duct to provide the cleaning action.

Experiments show that the serpentine cleaner accomplishes substantial trash removal from seed cotton without damage to the fiber.

Because the power requirement of the serpentine cleaner is negligible compared with that of a cylinder cleaner, which consumes approximately one horsepower per cylinder, gin machinery manufacturers could make an economical application of this method of cleaning in their future commercial developments.